RUBBER-GROWING INDUSTRY OF THE PHILIPPINE ISLANDS

COST OF PRODUCTION *and* PROFITS

BUREAU OF INSULAR AFFAIRS, WAR DEPARTMENT

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RUBBER-GROWING INDUSTRY OF THE PHILIPPINE ISLANDS.

ON BOARD STEAMSHIP MANCHURIA,
Off Formosa, November 9, 1910.

SIR: Referring to your letter requesting information relative to the rubber-growing industry in these islands, I have the honor to inform you that copies of it were forwarded to the Director of the Bureau of Science, the Director of the Bureau of Agriculture, and the Director of the Bureau of Forestry, and that each of those officials was requested to furnish such information as was in his power to give.

The Director of the Bureau of Agriculture sent out thirty-two letters to rubber planters in the Moro Province, requesting information based on their practical experience. Up to July 7 but one reply was received and so far as I am aware no others have since come in.

My own absence on my long annual inspection trips prevented me replying sooner to your inquiry. As you are aware, I addressed a letter to you under date of July 7, 1910, embodying all the information which I had been able to gather up to that date, but as it seemed probable that I might obtain more reliable information relative to the cost of clearing the land and planting it, and relative to the returns which might be received from catch crops, I have delayed forwarding this letter until the present time.

I knew that I could obtain especially reliable information relative to the cost of bringing land under cultivation from Mr. C. H. Lamb, Superintendent of the Iwahig Penal Colony. As you know, the land under cultivation by the convicts at this Colony has for the most part been made available by clearing away the virgin forest and as a strict account of all labor used is kept, Mr. Lamb's figures should be rather trustworthy. They were received just prior to my departure from Manila.

LAND LAWS.

As you yourself are doubtless aware, no corporation authorized to engage in agriculture may own or control more than 2,500 acres of land. There is no restriction as to the amount of land which an individual may lawfully own, but there *is* a restriction on the amount of public land which he may purchase, which may not exceed 40 acres. A corporation may purchase not to exceed 2,500 acres of public land. The minimum price which may be charged for such

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land is ₱10 per hectare, and where the land in question is wild and uncultivated it is our custom to charge this minimum price. The provisions of existing law relative to the rental of public lands are more liberal than are those relative to their sale. Either an individual or a corporation may rent not to exceed 2,500 acres. Leases run for 25 years with the privilege of renewal at the end of this period for an additional 25 years. The rental price can not be less than 50 centavos per hectare (approximately 10 cents, gold, per acre) during the first 25-year period, nor more than ₱1.50 (approximately 30 cents, gold, per acre) per hectare during the second 25-year period. It is our custom to charge the minimum price when wild land is taken up as we are very desirous of seeing some part of the enormous area of rich agricultural public lands in the islands brought under cultivation.

If the product from 2,500 acres would not be sufficient, several individuals could rent 2,500 acres each and make such arrangement relative to the sale of their products as might seem advantageous to them.

FAVORABLE CONDITIONS IN SOUTHERN ISLANDS.

All informed persons seem to be agreed that it is highly desirable to establish rubber plantations in the southern part of the Philippines outside of the typhoon belt, owing to the fact that the rubber producing trees ordinarily planted are somewhat brittle and are liable to suffer injury as the result of a heavy wind storm.

There are very extensive areas of public land suitable in every way for rubber planting in Mindanao, Basilan, Tawi Tawi, and Palawan, and, as you doubtless know, these regions are almost entirely free from very violent wind storms.

Land in the Agusan River Valley is especially well suited to rubber growing. Land in the vicinity of the river itself has the advantage of uninterrupted communication with the sea by water. The population of this valley is sparse, and public lands may be rented there in large tracts. According to the best information which I have been able to obtain, drought is absolutely unknown in this region. While it appears to be heavily forested, much of the vegetation is in the form of comparatively small trees, vines, etc., which can be cleared away at small expense, leaving a few very large trees which may be allowed to stand without interference with the growth of any plants not harmed by a moderate amount of shade.

In the subprovince of Bukidnon there are immense grassy plains covered not with cogon, but with pasture grass, which is not ordinarily more than knee high, or waist high at the outside. These lands are very readily brought under cultivation, and no preliminary clearing whatever is necessary. They lie at an altitude of from 900

to 3,000 feet above sea level, and the climate is cool and healthful. During a period of some three years since this subprovince was established as a political division, it has, I believe rained every month. The people, however, state that once in five or six years a drought is likely to occur. Any more or less remote danger from this source can be avoided by arranging for irrigation. This country also is sparsely inhabited, and the people are pacific. The nearest port is Cagayan de Misamis, where there is a pier alongside of which coast guard boats can lie. A good trail, which will soon be converted into a cart road, affords communication with the coast on the east side of the bay, from which communication may be had with Cagayan de Misamis by water, or around the bay over a fine automobile road. However, on the east side of the bay there is a sheltered cove where a pier, alongside which interisland steamers could lie, could be readily constructed.

I have seen Ceara rubber growing both in the Agusan Valley and in the subprovince of Bukidnon. In both instances young plants were extraordinarily robust.

CEARA RUBBER TREE.

As the rubber planting industry is so new in these islands, and as the variety of rubber producing trees which may be planted is considerable, it is not easy to make a reliable statement as to the returns which may be expected. Undoubtedly the tree which gives the quickest return is the so-called Ceara rubber tree. As previously stated, it grows with extraordinary luxuriousness in the Agusan River Valley and Bukidnon. There seems every reason to believe that it would produce as abundantly here as anywhere on earth. I have shown samples of Philippine Ceara rubber to persons claiming to be experts, and they pronounce them to be of the best quality. You can obtain samples of Ceara rubber of excellent quality by showing this letter to the Director of the Bureau of Science and informing him that I have requested that you be furnished such samples from the supply of Ceara rubber which I recently gave him for a commercial exhibit in the museum on Calle Anloague.

The following information relative to Ceara rubber is taken from a Bureau of Agriculture circular on rubber:

In British and German East Africa Ceara rubber is looked upon very favorably. Considerable tracts of land have been planted with it during the past few years, and others are being planted. The practice there is to plant the seedlings in rows 12 feet apart and 6 feet apart in the row on lands that have been cleared of stumps and underbrush at the beginning of the rainy season. Every other tree in the row is "bled" to death while still young, leaving the permanent trees at distances of 12 x 12 feet.

The tree thrives best in a good friable loamy soil of fair depth, and where the temperature and humidity are high, such as exists at many parts of the

coast and other similar districts; but the elevation must not exceed 3,000 feet, as grown above this height it has been proved to contain too much rosin to be of sufficient commercial value.

Propagation is usually effected by seeds, planted in seed beds, though they are sometimes planted "at stake"; but plants may be grown from cuttings. Seeds for planting should be at least a year old from the time they fall from trees, and the latter should be from three to four years old, as seed collected from younger trees does not produce vigorous plants. If fresh seed is planted, i. e., seed newly collected, germination is very poor, if at all, whereas seed one or two years old germinates readily and well, and gives good results.

Ceara trees come into bearing at about 3 years of age, and produce well until the tenth year, after which producing is not profitable.

Twelve thousand Ceara rubber trees planted in Siasi produced seed at a little more than 1 year of age.

The following information on Ceara rubber in general, and especially in the Philippines, is taken from a report on the cultivation of rubber by Dr. J. W. Strong, the same having been furnished me by the Bureau of Forestry.

Ceara rubber, so called from the province of that name in Brazil where it has its habitat, is known botanically as *Manihot glaziovii*, natural order Euphorbiaceæ, to which also belongs our common casava plant (*Manihot utilissima*), better known as "camote cahoy."

The Provinces of Ceara and Clara, Brazil, are the so-called dry provinces. Quoting from the report of Robert Cross, a noted botanist to the Indian Government in 1877, he describes the locality as possessing "a very dry, arid climate for a considerable part of the year. The locality traversed by me nowhere seemed to be elevated more than 200 feet above the sea. The soil was in places a sort of soft sandstone or gravel which was bound up in the most extraordinary manner." In other places he "came on a large tract of land covered with immense masses of gray granite. Many good sized rubber trees were growing in the spaces between these granite masses."

The Ceara tree is of moderate size, from 30 to 50 feet high, and 8 to 24 inches in diameter. The leaves are palmate, deeply cut into three, five, or seven oblong ovate lobes, smooth on both surfaces, thin in texture, deep bluish green above, and light beneath. Some of the young plants show a pink petiole. The flowers are large, unisexual and very numerous. The fruit is a round capsule less than 1 inch in diameter, containing three highly polished seeds variously mottled in color. The seeds have an extremely hard coat, and if kept dry, retain their fertility for years. When the seed capsule becomes dry, it bursts with considerable force, throwing the seed several yards away from the tree. I have found plants growing 50 feet from the nearest tree.

Ceara rubber is gathered in Brazil and shipped as "Ceara scrap." Only the simplest, crudest method is used. The collector, before beginning work, sweeps the sticks and stones from about the tree, and after stripping off the thin outer bark, he hacks and cuts the tree from the base to as high as he can reach, letting the latex or milk trickle down the tree to the ground. The latex coagulates very rapidly when left to itself, and collected in this manner is loaded with all sorts of impurities. To quote from Brant's India Rubber, Gutta-Percha, and Balota: "Ceara rubber has a beautiful amber color and is nearly transparent, a property which, according to Marellet, is not possessed by any other rubber. The latex of Manihot is at least equal to, and perhaps superior to that of Hevea (Para), as it contains fewer nitrogenous substances which

produce fermentation, and considerably less water. Instead of allowing the milky juice to trickle down the tree, it might be caught in cups and immediately mixed with alkaline water. In this manner the latex would be kept liquid for some time. In Ceara experiments have been made of this kind with excellent results, but unfortunately the native will not listen to anything new."

Ceara being such a quick grower it has been found impracticable to plant any catch crop between it after the first year. Hemp was tried in this province, and, while it did not affect the growth of the rubber, after two years the hemp was either dead or so stunted that it was of no further use.

In selecting land for planting Ceara two things must be considered. The land must be well drained, and should be protected from very high winds. Close planting will to a great extent protect from the high winds, but a wind brake of forest trees left standing would be valuable.

While Ceara will grow on most any soil, well drained, the soil and climatic conditions have great influence on the amount of latex produced, and consequently the amount of rubber contained therein. The richness of the soil, rainfall, season, and humidity of the atmosphere all play important parts in the yield of rubber, not only of Ceara, but other varieties; but of this more later on.

Ceara is readily propagated by seeds or cuttings, and stands transplanting well as far as living is concerned, but transplanting I have found often results in crooked, stunted trees, branching very low down. My experiments from cuttings have been very successful, so far as the cuttings taking root and growing, and the young trees seem to have plenty of latex. Those examined after one year have well developed root systems and the scar at end of cutting above ground entirely healed over.

In making a planting from cuttings, only smooth, straight branches from the best grown, highest yielding trees should be selected, and should not exceed 1 inch in diameter. The terminal ends of branches may be used with good results if planted at once, care being taken not to injure the tender bark. The larger cuttings should be about 12 inches in length, the top cut should be made sloping about 1 inch or more above a bud or leaf scar, and painted over with white lead; this will prevent decay and probably a hollow trunk. The bottom cut should be smooth, and just below a bud. The cutting can be kept in a cool shady place for a day or two without apparent harm. In planting the cuttings care should be taken to get them in the ground straight up, so as to get a straight trunk, and a hole must be made for the cutting, as shoving the cutting into the ground will very often result in slipping the bark and destroying the bud below ground, causing loss of plant or greatly delayed growth.

If it is decided to plant from seed, which no doubt is the easiest and best way, the land should be cleared and burned, and then laid off by line with stakes, perfectly square at the interval decided on for planting. The seed coat, being very hard and dense, should be filed on one side at the caruncle end, care being taken not to file too deeply, in which case there will be a loss of 100 per cent as ants and other small insects are very fond of the kernel, and will eat it up before germination starts. After the seed starts to germinate insects do not bother it.

The ground should be loosened for at least 6 or 8 inches deep at spot where seed is to be planted, and from three to five seed planted at each stake. If seed are planted in April or May the plants will be 2 feet high within a few weeks, and a catch crop of corn or palay, preferably the latter, should be planted to shade the ground and prevent it from washing, and more especially is this needed if the ground is rolling. The resulting crop of palay or corn will, as a rule, more than pay all expenses for the first year, and the ground will be comparatively free from weeds. About two weedings are all that will be required during the second year, and after that very few weeds will be found to grow.

After the tree is once started it should not be disturbed, as hoeing or digging about the roots of the young tree seems to cause crooked growth with low forking. Trees planted in Basilan in well plowed land, which were afterwards cultivated, while making good growth practically all branched low down, few reaching as high as 5 feet before branching; while trees not disturbed, planted in the hard ground from same seed, at the same time, made as good growth, with smooth, straight trunks from 6 to 10 feet before branching.

The tendency of Ceara is to make tall, straight trunks, if not disturbed, and as tapping will rarely or ever be done higher than 8 feet, the young tree may be thumbnail pruned at that height, by pinching out the terminal and causing the tree to branch. This will give a uniform appearance to the grove, and will give an increased circumference to the tree. In rich soil the tree makes a very heavy top, and it is a good idea to prune it back rather severely. In localities of heavy wind small branches may be brought across from one fork to the other, the bark removed from one side and on a large fork, the two surfaces brought together and tied in place will unite in a very short time and will act as a brace or truss, preventing the tree splitting.

The question of distance depends greatly on soil and locality. The richer the soil, the greater distance the trees should be planted apart, up to 25 by 25 feet; but it is thought that about 14 by 14 feet is a good distance to plant, and even more closely if high winds prevail. Planted at 14 by 14 feet, the branches will be touching in three years. The tree may be planted anywhere from sea level to 4,000 feet altitude.

Very little experimental work has been done with Ceara rubber, except in the last two or three years, and the yield per tree is given at various amounts. Herbert Wright, perhaps the greatest authority on rubber, places the yield of a mature Ceara rubber tree at 1 pound per year; this for Ceylon. Other observers place the yield as high as 10 pounds per tree per annum.

TAPPING IN THE MORO PROVINCE.

On August 20, 1908, the writer decided to start a series of experimental tappings of young Ceara trees grown from seeds, the trees being just 3 years old on that day. Two hundred trees were taken for the experiment and numbered from 1 to 200 as they ran. The average circumference was 22.1 inches, and the average length of tapping surface was 32.5 inches.

At this time the trees were leafed and in full bloom. It was decided to make the series of tappings 7 days each for 21 days, with a rest of 2 weeks between each 7 days.

The full "herringbone" system was used, with laterals out 8 inches apart. Small zinc drip-cups, with hooks to fasten to bark, were fixed at top of perpendicular. Each cup had a small round hole in bottom, next to tree, in which a wick was passed to permit a constant flow of ammoniated water down the cut. At the bottom of the perpendicular a piece of curved tin was inserted into the bark, conducting the latex to a cup at the base of the tree.

It was found that one-half of 1 per cent ammonia water in water placed in the drip cups would keep the latex fluid for days, and each collector carried a large bottle of the ammoniated water, a small amount of which he poured into the drip cup before tapping. Each collector also carried a squirt can of the same solution, and after all laterals were tapped a few drops were allowed to flow down the cut. This seemed to promote the flow greatly, and there was scarcely any scrap left in cuts. In fact there was so little that no inconvenience was caused to tappers in reopening the cuts each morning, and no effort was made to collect the scrap.

During the first seven days trees No. 1 to 100 were tapped every day, tapping was done from about 6 a. m. to 8.30, and resulted in 5,100 grams of dry rubber, or about 1⅞ ounces per tree.

The second seven days, Nos. 101 to 200 were tapped on alternate days for seven tappings, and resulted in 4,500 grams.

After resting two weeks the third tapping was begun and beginning with No. 2, alternate trees, all even numbers, were tapped for seven days, but tapping was done in the evening from 4 o'clock to about 6. It was noticed that the trees tapped latest in the evening gave the most latex.

This tapping resulted in 3,600 grams of dry rubber, making a total yield of 13 kilos 200 grams for the entire tapping, almost 4¼ ounces per tree for 21 tappings.

	Grams.
First 7 tappings	5,100
Second 7 tappings	4,500
Third 7 tappings (evenings)	3,600
Total	13,200

Average per tree, 132 grams.

Average per tree per tapping, 6.29 grams.

Greatest amount from a single tree was from tree No. 197, which gave 224 grams of dry rubber during the seven tappings (second series, and is included in the general average). After a rest of two weeks this tree was tapped again every day for seven days, tapping being done in the evening, and yielded 180 grams of dry rubber. After another period of rest for two weeks it was tapped again every day for seven days, mornings, and yielded 104 grams of dry rubber. During this tapping it was noticed that laterals on left side of perpendicular ran well, but only top and bottom laterals on right side gave any latex. Some three days before the last series of tappings there was a severe wind storm and this tree was split down the main fork for nearly 2 feet, which may account for its behavior. The size of this tree 3 feet from the ground is 36½ inches circumference, and 54 inches the length of perpendicular of tapping surface. Total amount of rubber from this tree, 508 grams, or a little more than 1 pound. The last two tappings from this tree are not included in the general average, as it was tapped singly.

There was a marked difference in the yield of the trees. Quite a number were noted giving from 15 to 20 grams of dry rubber per tapping, while others gave scarcely any. One fine large tree in particular would only run a gram or so of amber colored latex, which would coagulate in spite of the ammonia.

Two trees in the test had been broken off by the wind some two months before, and the tops were entirely cut away, leaving bare stumps about 4 feet high, but each gave plenty of latex at each tapping.

Two trees standing near where some hemp strippers had been working about five months before were tapped alone, and gave almost double the amount of latex that other trees of same size gave remote from them. This is believed to be due to the large amount of refuse hemp waste, which was surrounding these two trees, and which had thoroughly decayed.

The men used for tapping were a Tagalog, a Yacan Moro, and a Tiruray. The tapping knife used was a modified Ceara rubber knife used in Ceylon. All of these men quickly learned to handle the knife so as not to cut the wood, and in a few days were quite expert tappers.

After the latex had ceased to flow in the morning or evening, it was brought in and after straining through brass wire gauze was poured into tin basins for coagulating.

Acetic acid was used to coagulate the latex, just sufficient being used to render the solution slightly acid. When the rubber had all coagulated, leaving the water clear, which was in about two or three hours, the spongy mass was pressed with the hands to expel the water, and afterwards passed through the rolls of an ordinary clothes wringer, which squeezed out most of the water and reduced the cake of rubber to about one-eighth inch in thickness. These wet cakes, or "biscuits," were then placed on galvanized wire racks under sheds to dry.

There was invariably a small amount of scrap each morning or evening due to ants getting into the cups, in which case a small mass of coagulated rubber formed about them, due probably to the formic acid which they contain; formic acid being one of the most powerful coagulants of latex.

One man can tap and collect very easily from 100 trees per day, beginning at 5.30 and working until 8.30 a. m., at which time tapping should be discontinued, unless it is cloudy; in such case tapping can go on for an hour longer. If tapping is done in the evening also a larger number of trees can of course be handled.

So far no fungus or insect pests have attacked Ceara rubber. Wild pigs, however, are very fond of the starchy roots and will do great damage if not fenced out or kept away by hunters.

Other rubber producing trees which may be planted are the following:

INDIA RUBBER TREE.

Ficus elastica.—This tree has been grown to some extent on a commercial basis in India.

Markham states that the trees may be tapped at the age of 25 years. From that time until the trees are 50 years of age the yield is estimated to be about 40 pounds per tree every three or four years. Only about 40 trees of this species can advantageously be planted on an acre of land and on this basis the yield of rubber per acre might be estimated at about 500 pounds per year. My information is that *Ficus elastica* is no longer grown as a rubber producer, even in its native habitat where other rubber producing trees have proved more profitable.

PARA RUBBER TREES.

Para rubber.—A large number of seeds have been distributed by the Bureau of Forestry. The growth of young trees in the Moro Province has been very rapid. The quality of the rubber actually produced will not be known for a year or two more when trees are large enough for tapping. The tapping of undersized Para rubber trees gives a latex which has too large a proportion of resin. The trees should be six years old when tapped.

The following information relative to Para rubber is taken from a report on the cultivation of rubber by Dr. J. W. Strong:

In November, 1905, 20,000 Para seedlings were secured by the government of the Moro Province from the Forestry Bureau in Manila and were distributed,

gratis, to American and native planters, and to the Farm at San Ramon. Para did not do well at San Ramon on account of soil conditions, but in many other parts of the Province, notably Basilan, Davao, and the foothills back of Zamboanga—it has made remarkable growth.

Para rubber (*Hevea brasiliensis*) is also being planted quite extensively in this Province, and is making fine growth. This rubber is propagated from seed entirely, and usually the seed are laid down in a nursery and transplanted when the plants have reached a proper size.

The Para seed does not retain its fertility very long (from 30 to 60 days), and no time should be lost in getting seed planted when received. No filing of seed is necessary and ants do not bother them.

Para is a very deep feeder and its early habit of growth seems to make it an ideal plant for planting through hemp. Planted through hemp 18 by 24 feet, at same time or soon after planting the hemp, it would in no way interfere for at least five years. After that time it would shade the ground considerably, but as it would be of tappable size in the sixth or seventh year at most, the hemp could be entirely removed, having paid all expenses and a good dividend in the meantime.

There is no doubt that the yield from mature Para trees is, as a rule, greater than from Ceara, and where the soil and rainfall are right Para is the rubber to plant.

Para is tapped, and the latex treated, in about the same manner as Ceara, the latex flowing more freely and not being so prone to coagulate spontaneously.

The following information on Para rubber is taken from a report of W. I. Hutchinson, of the Bureau of Forestry:

During a recent trip to the San Ramon Farm, made at the request of the Superintendent, in order to investigate the illegal clearing of lands in the vicinity of the Farm, measurements were taken of the Para rubber seedlings in the seed beds.

Seventy-five of the seedlings, raised from seed planted by the Forester on November 15, 1905, measured August 13, 1906, age 9 months, had an average height of 4 feet 2 inches, with a maximum height of 5 feet and 5 inches.

Measurements of the seedlings obtained by the government of the Moro Province from the Bureau of Agriculture at Manila, and transplanted into seed beds at the Farm, gave the following results:

Date of planting in boxes at the Lamao Forest Reserve, Bataan Province, Luzon, November 13, 1905 (?).

Date of transplanting into seed beds at the San Ramon Farm, January 5 to 10, 1906.

Date seedlings were measured, August 13, 1906.

Age of plants, 9 months. Number of plants measured, 75.

Average height, 3 feet 8 inches. Maximum height, 4 feet 7 inches.

The Superintendent of the Farm informed me that fully 1,000 of the 4,725 plants obtained from the Bureau of Agriculture failed to grow, after transplanting, on account of crooked tap-roots, caused by planting the seed in boxes containing but a shallow layer of soil.

In box planting, where it is expected to ship the seedlings, 6 or 8 inches of soil should be placed in the bottom of the box. This will give the tap root a chance to develop and will not cause it to curl up in a spiral form.

Not more than 50 plants should be placed in a box 18 by 24 inches. The boxes received from the Bureau of Agriculture averaged 175 plants, and in many

cases the roots and stem formed such a tangled mass that it was difficult to separate the plants without injury.

As an experiment, 18 Para seedlings and 14 Ceara seed were planted at the Farm on May 28, 1906, in the sandy soil 150 feet from the beach, where the underground water is more or less brackish. Only four of the Para plants are living at the present time (August 15, 1906), the remainder having wilted and died. A few of the Ceara seed sprouted, but the plants, after growing a few inches in height, gradually became less and less vigorous and finally died. This would seem to prove that Ceara and Para are not suited to land containing an excess of salt, or where the water is at all brackish.

During the writer's stay at the Farm, 300 seedlings of Para were set in a permanent plantation.

The land used for the plantation was cleared by the Spaniards many years ago. In 1904 it was plowed, but allowed to grow up to weeds again. In the spring of this year (1906) the Superintendent had the plot cross-plowed with a 10 and 6-inch plow, and several weeks ago replowed the area with a 6-inch plow, and harrowed and disked it.

The planted area is situated about a half mile from the shore. The soil is a rich clay-loam, fairly porous, and containing but a few scattered boulders.

The seedlings were brought from the nursery to a shady spot near the planting area in large baskets, the roots being covered with earth. A "puddle" of clay and water was made in a bucket, and the plants, as needed, taken from the baskets, the roots placed in the bucket, which was carried to the hole where the plants were to be set. By using this method, the roots of the seedlings were protected from the drying influence of the air.

As the plants have been in nursery beds for nine months, it was almost impossible, on account of the length of the roots, to dig them out without injuring the tap root to some extent, and a number of failures will probably result from this cause.

Rows 18 feet apart were marked off, and the plants set every 18 feet in the row. It is intended that abaca shall be planted in between the rows of rubber.

As neither the Superintendent of the Farm nor the Forester knew how large seedlings should be treated when planted, it was decided to try the following methods:

First three rows (66 plants) cut back to 18 inches and all leaves removed.

Fourth to sixth rows, inclusive (66 plants), cut back a foot, but lower leaves not removed.

Remaining 8 rows (176 plants), new growth, formed during the last few weeks only, removed.

It is hoped that by trying these different methods, and watching the growth of the plants, some clew as to the proper treatment of large seedlings may be obtained.

The seedlings which were sold, on account of their large size, were placed in a box 18 by 24 inches, with the tops projecting over the end, the roots being covered with earth. A hood of abaca leaves was placed over the box, and instructions to water the plants during transit once a day, in the evening, tacked on the side. All the seedlings treated in this manner stood a several days' journey successfully.

Para rubber trees are usually tapped first when 6 or 7 years old, and continue to yield rubber indefinitely.

CASTILLOA RUBBER TREES.

Castilloa elastica.—These trees are usually tapped first when 6 or 7 years of age, and continue to yield rubber indefinitely.

The following information on Castilloa rubber is taken from a report on the cultivation of rubber by Dr. J. W. Strong:

The first Castilloa brought into the islands was introduced by the San Rafael Plantation Co., of Basilan, in 1905, and has made phenomenal growth; some of the trees measuring 32 inches in circumference 1 yard from the ground, with a corresponding height and crown. Castilloa is perhaps the most handsome of the three rubbers now growing in the Province.

This rubber has not been planted so extensively as either of the other two, Davao District and Basilan having a few thousand. It is making wonderful growth in both localities, and will probably be more extensively planted. Castilloa has not been a general favorite in the East, as it does not come into bearing until 8 or 10 years of age and its rubber is hardly up to the standard of either Para or Ceara. It is propagated from seed, and stands transplanting better than either Para or Ceara. It may be propagated by cuttings but this is hardly practicable.

The tapping and coagulating of Castilloa latex is different from Ceara or Para, and need not be commented on.

CONDITIONS IN SOUTHERN ISLANDS.

Referring now specifically to the questions of your correspondent, rubber plantations might be located on the Agusan River, in the subprovince of Butuan, in the subprovince of Bukidnon, in the Moro Province, and anywhere in the southern half of Palawan without serious danger from heavy wind storms, and with all other conditions of climate and soil favorable. The elevation above sea level would be so slight as to be negligible, except in the subprovince of Bukidnon, where the maximum elevation available would be 3,000 feet, this being the height above which it is not deemed desirable to plant Ceara rubber.

The largest number of acres which a corporation which is authorized to engage in agriculture can control would be 2,500, and this amount of land could be purchased outright or leased. If purchased, the cost would be not less than ₱10 per hectare, which would probably be the actual cost price if wild land was taken.

Payments for land purchased from the Government may be made as follows: Twenty-five per centum at the time bid is submitted, and the balance may be paid in full upon the making of the award, or may be paid in one installment at the expiration of five years from the date of the award. All sums remaining unpaid after the date of the award bear 6 per centum interest per annum from such date until paid. The purchase can be completed only after five years of occupation and cultivation.

The annual taxes would be one-half of 1 per centum of the value of the property.

If land is rented, the cost of a 2,500-acre tract would be approximately as follows: Survey by Bureau of Lands, ₱300 to ₱600, depending upon the difficulty of clearing the land. In the subprovince of Bukidnon, the cost of a survey should not exceed ₱150, as little or no brushing out would be required. The rental on a 2,500-acre tract would be approximately ₱530 per year, payable in advance. There would be no taxes on the land.

Transportation in the subprovince of Butuan would be by the Agusan River to the town of Butuan; thence by local steamer to Cebu. The Agusan River has, for a distance of more than 100 miles from its mouth, a minimum depth in dry weather of 3 feet, and any concern owning a rubber plantation on the river would, of course, need to operate its own launch.

It may interest you to know that the Province operates a 30-foot launch on this river. It is capable of carrying 50 sacks of rice on a 20-inch draught. It has a 7½-horsepower Mietz and Weiss petroleum engine; has a speed of 10 miles per hour, and costs to operate approximately ₱8 per day of 10 hours, including salary of native engineer.

The cost of freight from Butuan to Cebu, and from Cebu to the world's markets, is doubtless better known to the Manila Merchants' Association than to me, and at all events can readily be ascertained.

The soil in the Agusan River Valley is a rich loam made up from the wash of the immense forests through which the river flows.

The following report by Mr. C. B. Robinson, Economic Botanist of the Bureau of Science, embodies the latest information which I have been able to obtain relative to rubber-growing in the Moro Province:

RUBBER INVESTIGATIONS IN MORO PROVINCE, JUNE, JULY, 1910.

The writer was detailed from this Bureau to accompany Mr. C. A. Littler, representing a firm of British capitalists, who contemplated establishing a rubber plantation at some point in the islands that should prove suitable, where also there would be accessible a good supply of rubber and gutta-percha, obtained from wild plants. Mr. Frank E. Bost, a rubber specialist and the manager of the proposed plantation was also of the party, to which was added at Zamboanga, Mariano, the Forestry Ranger for the District. Great assistance was given by the officials of the Moro Province, and of the District of Cotabato.

It was therefore the aim of the expedition to see as much as possible of the places where the planting of rubber had hitherto been attempted, and to inspect localities which from extended inquiries seemed likely to prove suitable for a plantation.

Leaving Manila late on the afternoon of June 3, with stops at Dumaguete and Cebu, Zamboanga was reached on the 9th; San Ramon was visited on the 10th, and a more extended trip to Basilan was made on the 15th, with stops at Margosatubig, and Malabang, and a change of boat and overnight stop at Parang on the 16th–17th. Cotabato was reached at noon on the 17th and finally left on July 2, the trips in the mountains extending as far up the valley as Fort Pikit, and through the Liguasan March from Cabacsalan to Cotabato. The return steamer was taken on July 2 at Parang, and followed through her route to Zamboanga, Jolo, Port Banga, Dumaguete, and Cebu; Manila being reached before noon on the 10th.

The general results arrived at were that a site for the proposed plantation was found near Reina Regente, Cotabato; that all the three kinds of rubber-yielding trees which have been planted, Ceara (*Manihot glaziovii* Muell.-Arg.), Para (*Hevea brasiliensis* Muell.-Arg.), and Castilloa (*C. elastica* Cerv.), were found to make very satisfactory growth, but the first is so subject to injury, that its planting is being abandoned by those who have tried it most extensively; that a fairly large quantity of rubber (chiefly gutta-percha, the true rubber not being distinguished locally) is brought down the Cotabato Valley, though at present the supply is erratic, owing to the uncertainty of a market; several species of Ficus were found which upon rough testing proved to yield a certain amount of rubber. More extended observations follow:

SAN RAMON.

Near the buildings at San Ramon, there are young seedlings of Para, perhaps 200 in number, about 1 meter in height. The older trees are few in number, about 1 kilometer from the station in an easterly direction, near the Sax River; no cultivation has been given them, the tallest is about 6 meters, and nearly all have been more or less injured.

BASILAN, DR. J. W. STRONG'S PLANTATION.

This is situated a little over 1.5 kilometers from Isabela, and is by far the most extensive rubber plantation seen, and to the best of our information equally the most extensive existing in the islands. A rough plan is appended.

Originally, Ceara was almost exclusively planted followed quickly by Para and Castilloa. While the first has grown well and many

of the trees have reached a size suitable for tapping, it is so liable to injury from wild hogs, deer, and termites, that it is being superseded by the other species.

Measurements made at Dr. Strong's gave the following results. All are the circumference in inches, 3 feet above the surface of the ground. The growth of the Castilloa is especially remarkable.

Para, 4 years 6 months, 23, 23.5, and 22.

Para, 3 years 6 months, 16, 15, 11, 12.5, 13, 15.5, 12, 15.5, 13.5, 16, 16, and 15.5.

Castilloa, 3 years 10 months, 34, 35.5.

Castilloa, 2 years 10 months, 27, 22, 24.5, 25.5, 24, and 24.5. (There are 35 trees of this age, all bearing seed.)

Ceara, 2 years from cutting, 18.5.

Both the climate and the situation of Basilan are suited to rubber growing. Drawbacks exist in the wild hogs and deer; these can be kept out by suitable fencing.

Experimental tappings of rubber have already been made, with satisfactory results.

SAN RAFAEL PLANTATION, BASILAN.

This is situated about 3 kilometers west of Dr. Strong's, with which it is connected by a trail. The hacienda contains about 300 hectares. A number of the older trees are planted near the house. Measurements made of these gave the following figures:

Ceara, 5 years, 32, 39, 33, 33, 31.

Castilloa, 3 years 10 months, 28, 22.5, 26 (200 of this age).

There are said to be on the place 900 to 1,000 Ceara trees, 3 years old, and 100 to 200 Para, all small, 3 years old. There has been no cultivation, and injury has been experienced from hogs. None of the trees have been tapped, although some of them are quite of sufficient size.

MABGOSATUBIG.

There are two small plots of Ceara on opposite sides of the road in the place, about 3 years old, making good growth, one man having 25 trees.

BULUAN. (DATTO INUK.)

Beside the house of Datto Inuk at Buluan, there are some 35 Ceara trees, about 2.5 years old, planted very closely, about 1.5 meters by 1.5 meters. These are entirely free of weeds. Measurements same units as before; 16.5, 16, 12, 13.5, 17.5, 13.25, 15, 17.5, and 17.25. In addition, there are about 1,000 Ceara trees, 10 months old, in the hills at some distance, planted about 2.7 meters by 2.7.

PORT BANGA.

Mr. Redding of the firm of Williamson & Redding stated that at the head of the bay they had planted a considerable number of trees; that these had been planted and left without cultivation, and were a total failure. They are now planting and cultivating, but this has only recently been undertaken.

OTHER PLACES IN THE ZAMBOANGA DISTRICT.

Several other planters have rubber trees; the work has apparently not included cultivation, and the results attained are meagre. None of these were visited.

WILD RUBBER.

The chief supply of this comes from the Cotabato Valley, either from the head waters of the Rio Grande, or from the hills along one of its branches, the Dansalan, where three Indians of whom Bombay is the chief, gather an amount practically limited by their financial resources. It is chiefly obtained by the hill tribes, and comes out through Cotabato; some also is said to be exported through Sarangani.

Datto Piang's estimates of the quantity he could procure ranged from 400 to 500 piculs every three months; he formerly got 700. A small quantity comes from the Buluan country; the rest is divided between the Dansalan, and the headwaters of the Rio Grande, as stated above. Bombay gets about half of the Dansalan output, but at present little or none, owing to the uncertainty of payment. Prices there range from 12 to 30 pesos per picul (137.5 pounds). A fairly large lot was seen at Cotabato, whence it is exported to Jolo; the dealer there was also seen, and it appears that no cleaning is done except washing, first in hot water, and then working with the feet in cold water; it is then sent to Singapore where there is a machine. The export from Cotabato for the 11 months of the then current fiscal year (ending May 31, 1910) was nearly 87,000 kilograms.

Small quantities are exported from Margosatubig to Zamboanga, one dealer sending about 5, and another 2.5 piculs per month. This is obtained from the Camaralang River.

No distinction is made between gutta-percha and vine rubber, but the great bulk from description and the samples seen is of the former. The vine rubber does, however, form a part of the export, but it is more difficult to obtain, and has brought no higher prices.

SITES FOR RUBBER PLANTATIONS.

With this is involved the labor problem.

Along the banks of the Rio Grande, the land is too low and too wet for rubber planting, except in a few places. The best of these seemed to be in the vicinity of Reina Regente, where the south side

of the river is approached by rolling hills, well-wooded attaining elevations of 60 to 100 meters. The town of Dalauan (Datto Piang) is a few miles below, and the prospects of obtaining a sufficient supply of labor through his cooperation seem to be good. Good land is said to be available above Pikit, but the transportation problem so far up the river would be too great, and the supply of labor insufficient for work upon an extended scale. A limited amount of good land could be found on the southern arm of the river, hardly sufficient for the purposes desired.

C. B. ROBINSON,
Economic Botanist.

ESTIMATES OF EXPENSE AND PROFIT.

Practically all available land is now covered with timber. This of course at once raises the amount of the cost of clearing. The difficulty involved in obtaining really reliable information relative to the cost of clearing land, the cost of planting, and the returns derived from catch crops affords the true explanation of my long delay in replying to your letter.

The following is an estimate furnished me by the Director of the Bureau of Agriculture:

Cost of clearing land.—The cost of clearing heavy jungle is estimated to be about ₱20 per acre, this includes the slashing, cutting of trees, burning and disposal of the larger trunks.

The cost of clearing average jungle is estimated at ₱16 per acre.

The cost of clearing open jungle is estimated at ₱12 per acre. (Estimated by hemp growers.)

Cost of planting three principal kinds of rubber per acre.—An idea can be had of this by giving the estimated cost for Para rubber in the Malay Peninsula, as estimated by R. G. Watson:

Estimate for 1,000 acres; 250 acres to be opened each year.

First year:	
Premium	₱3,000
Survey fees	1,000
Rent	1,000
Clearing, felling, and burning 250 acres (₱15 per acre)	3,750
Lining, holing, and planting 250 acres (₱6 per acre)	1,500
Plants	800
Roads and drains (₱6 per acre)	1,500
Houses for laborers	2,000
Lines	1,500
Medical—Hospital, medicines, etc	2,000
Labor—Advances, immigration, etc	1,500
Superintendence	3,600
Tools and sundries	1,000
Total	24,150

Second year:	
Rent	₱1,000
Clearing, felling, and burning 250 acres	3,750
Lining, holing, and planting 250 acres	1,500
Plants	800
Roads and drains	1,500
Medical	1,000
Labor	1,000
Superintendence	4,000
Tools and sundries	750
Weeding 250 acres	2,500
Supplying	100
Total	17,900
Third year:	
Rent	1,000
Clearing, felling, and burning 250 acres	3,750
Lining, holing, and planting 250 acres	1,500
Plants	800
Lines	1,500
Roads and drains	1,500
Medical	1,000
Labor	1,000
Superintendence	4,000
Tools and sundries	1,000
Weeding 500 acres	6,000
Supplying	100
Total	23,150
Fourth year:	
Rent	1,000
Clearing, felling, and burning 250 acres	3,750
Lining, holing, and planting 250 acres	1,500
Plants	800
Roads and drains	1,500
Medical	1,000
Labor	1,000
Superintendence	4,000
Tools and sundries	1,000
Weeding 750 acres	12,000
Supplying	100
Total	27,650
Fifth year:	
Rent	1,000
Roads and drains	800
Medical	1,000
Labor	1,000
Superintendence	4,000
Tools and sundries	1,000
Weeding 1,000 acres	15,000
Total	23,800

Sixth year:	
Rent	₱1,000
Roads and drains	800
Labor	1,000
Medical	1,000
Superintendence	4,000
Tools and sundries	1,000
Weeding 1,000 acres	17,000
Total	25,800
Seventh year:	
Rent	4,000
Roads and drains	800
Medical	1,000
Labor	1,000
Superintendence	4,000
Tools and sundries	1,000
Weeding 1,000 acres	17,000
Total	28,800
Eighth and following years as seventh year	28,800

The cost of weeding gradually decreases till in the eleventh year it is practically nil.

Profits.

Seventh year:	
250 acres, planted 150 trees per acre at 1 pound rubber per tree, sold at 3s. per pound	₱48,214
250 acres, planted 150 trees per acre, at 1½ pounds rubber per tree	72,321
Total income	120,535
Less cost of production, shipping, etc., of 93,750 pounds at 1s. 6d. per pound	60,268
Net profit	60,267
Eighth year:	
250 acres at 1 pound per tree and 3s. per pound	48,214
250 acres at 1½ pounds per tree and 3s. per pound	72,321
250 acres at 2 pounds per tree and 3s. per pound	96,428
Total income	216,963
Less cost of production, etc., 253,125 pounds at 1s. 6d. per pound	108,482
Net profit	108,481
Ninth year:	
250 acres at 1 pound per tree and 3s. per pound	48,214
250 acres at 1½ pounds per tree and 3s. per pound	72,321
500 acres at 2 pounds per tree and 3s. per pound	192,856
Total income	313,391
Cost of production, etc., 243,750 pounds at 1s. 6d. per pound	156,696
Net profit	156,695

Tenth year:

250 acres at 1½ pounds per tree and 3s. per pound	₱72,321
750 acres at 2 pounds per tree and 3s. per pound	289,280
Total income	361,601
Less cost of production, etc., 262,500 pounds at 1s. 6d. per pound	180,800
Net profit	180,801

Eleventh year:

1,000 acres at 2 pounds per tree and 3s. per pound	385,710
Cost of production, etc., of 300,000 pounds at 1s. 6d. per pound	192,857
Net profit	192,853

And so on each year, annual profit ₱192,853, with a probability of still increased yield.

This estimate would apply to Castilloa and Ceara, as there would be very little difference in the cost of seed or young plants.

Cost of going over once with bolo, cutting weeds and brush, ₱4 per acre.

Returns from catch crops.—The amount of these crops, such as corn, sweet potatoes, casava, etc., that can be grown per acre will depend somewhat on the way the trees are set out. Some planters advise that the rubber trees be originally planted 15 feet apart, the object of this being to cover the ground with shade as soon as possible to prevent the growth of weeds and underbrush. Three or four tappings can be made on these trees before they crowd to such an extent that it will be necessary to take out the surplus trees, leaving the trees in the permanent grove 30 feet apart. In case the trees are planted 15 feet apart, only a very small portion of the land could be planted to catch crops, as in cultivating it will be necessary to leave a strip 6 feet wide along each row of trees to prevent injury to the trees in cultivating. If the trees, however, are set out originally 30 feet apart, the intervening spaces may be occupied by catch crops, provided there are markets for such crops as are grown. Only about 85 per cent of the total area should be considered available for catch crops.

Corn should yield about 30 bushels per acre, worth in Manila ₱1.10 per bushel. Sweet potatoes should yield from 100 to 200 bushels per acre, depending upon the character of the soil and the kind of cultivation. This crop is more or less perishable, but large quantities could be used for feeding laborers. Some hemp planters have claimed that they have grown a sufficient quantity of sweet potatoes between the rows of hemp to pay for the cost of weeding the hemp each year. Casava will yield from 20 to 30 tons of roots per acre. Up to the present time it has not been found profitable to grow casava, owing to the fact that suitable market can not be found in the Philippine Islands for the starch and when shipped to New York the cost of manufacture and transportation about equals the price obtained.

Cost of clearing, plowing, and harrowing.—Cost of plowing loose sandy soil covered with cogon once, ₱3 per acre. Cost of harrowing, ₱1 per acre.

A person who has a coconut plantation in northern Mindanao on cogon land claims that it is necessary to plow the land each year and harrow at least once a month in order to keep down the cogon, unless some crop is grown between the trees, in which case the cultivation of the crop should be sufficient to keep down the weeds and vines. It was suggested to this person that he plant the intervening spaces in velvet beans and keep the velvet beans from destroying the young trees by having a man go over the ground at least every two weeks

and chop off all vines approaching the trees. The cost of this need not exceed ₱0.20 per acre for each time.

Cost of seed.—Ceara rubber seed should not cost over ₱2 per 1,000 in large quantities. Allowing 250 seeds per hectare, the cost for seed would be ₱0.50.

The following estimate of the cost of clearing land and planting it in coconuts, and of the profits derivable from the sale of forest products and from catch crops has been furnished me by Mr. C. H. Lamb, Superintendent of the Iwahig Penal Colony. So far as concerns the cost of clearing for coconut planting and the profits derivable from catch crops, these figures will answer as well for rubber as for coconuts. It should, of course, be remembered that mangrove land is not suitable for rubber production.

The island of Palawan differs geologically and geographically from other islands in the Philippine group.

It is different in its fauna and flora, and in its rainfall, and to quite an extent in its seasons.

Peculiarly, good hemp will not grow in many localities, nor will some other plants which thrive on other islands, due probably to the topography of the country.

The soil is varied, and in fact, over the greater portion of the island the soil which is feasible of cultivation differs in character, even in small areas which can be described by the word patchy.

There are two crops, however, which thrive well on the island of Palawan, where the land is at all susceptible of cultivation; same are rice and coconuts. The same statement can almost be made as regards corn. (The average corn yield is as good as the writer has seen anywhere, with the exception, that frequently patches of soil are found on which corn does not thrive, but peculiarly the same soil will grow good rice, and it will also grow good coconuts.)

The expense of preparing land for cultivation must always depend to a certain extent upon the manner or method, and particularly upon the location. The following figures can be accepted as a safe guide:

Felling trees will cost from nothing to ₱20 per hectare.

Cutting and burning will cost from ₱10 to ₱80 per hectare.

Stumping will cost from ₱10 to ₱150 per hectare.

The first plowing will cost from ₱3 to ₱10 per hectare.

Three plowings will cost from ₱5 to ₱20 per hectare.

Planting in either corn or rice will cost from ₱4 to ₱10 per hectare.

Taking into consideration all classes of land found; the level, rich, short grass land, free from timber and brush, which has only to be plowed, and which may be called first-class land. Second, the small valleys along the streams and in the mountain coves, almost always covered with forest more or less heavy, and which may be called second-class land. Third, the same kind of land covered with "bojo," or small brush, which may be termed third-class land. Fourth, particularly unfavorable locations, which may be termed fourth-class land.

Classification is made, considering that the best, which can be planted at the least expense.—It has been found by actual experience that the minimum average for planting the first crop of rice or corn is ₱32 per hectare.

The general average is ₱85 per hectare. This is a safe and conservative estimate, and will be found sufficient, taking into consideration all conditions.

The expense of ₱85 is divided as follows:

(*a*) Felling trees, ₱5.
(*b*) Cutting and burning, ₱20.
(*c*) Digging stumps, ₱40.
(*d*) For plowing, ₱14.
(*e*) Planting, ₱6.

If misfortune and unfortunate incidents come this average will still be found ample. However, to cover same, an additional allowance of ₱15 per hectare is made, which would make a maximum total of ₱100 per hectare.

Ordinarily through the island of Palawan, if forest land is cleared and planted, from 10 to 100 "trozos" can be had from 1 hectare of land. Same will average from 200 to 2,000 cubic feet, which will net from ₱40 to ₱400.

A safe and conservative amount as a return from 1 hectare of land is ₱110.

The minimum return from 1 hectare of land in rice harvest is 20 cavans, and the average maximum is 50, although 70 is not uncommon.

The average value of this rice or palay is ₱2.50 per cavan.

Therefore, the return from the rice crop from 1 hectare of land will average ₱40 to ₱125.

Forty-one pesos is assured, therefore 1 hectare of land cleared of ordinary timber and planted in rice will yield the first year ₱151, i. e., ₱110 in timber and ₱41 in rice or corn.

This same hectare of land, according to above figures, has been planted at a maximum cost of ₱100, thereby giving us a margin of ₱51 per hectare.

Regarding mangrove swamp, what I carefully compiled from actual experience shows that the firewood and tanbark therefrom can invariably be depended to pay the cost of clearing the land and planting.

* * * * * * *

The foregoing data are the basis upon which the writer works, or in other words, it can be assumed that throughout the island of Palawan the first quick return crop will pay for the clearing of the land, and on at least 50 per cent of the locations will also pay for the planting of the land in coconuts. The planting of the nuts will cost from ₱6.25 to ₱12.50, or 22½ cents per tree, or a maximum cost of ₱22.50 per hectare. However, it is usually done for less, and this is the maximum average. Also the quick return crop which has been planted on the land will produce a profit over the clearing of ₱22.50 per hectare, sufficient to pay the expenses of planting the coconuts, which are usually planted at about the same time the rice is planted.

The same land will produce two more quick return crops, that is, three quick return crops in all, without interference with the coconuts.

The best crops, according to the writer's experience, are, first, a crop of corn, subsequently two crops of mountain rice, by which time the coconuts will be too large to permit any further cultivation of rice or corn, but camotes and so forth may be planted. However, the latter are not considered a profitable crop. If the first quick return crop does not produce sufficient revenue to pay the expense of planting the coconuts, the planter has a maximum expense of 22½ cents per tree. There will be no additional expense for the next two years of the tree's life if quick return crops are planted; on the contrary there is usually a profit. However, if the second and third quick return crops are only sufficient to pay the expenses of keeping the land clean, there are really only three years to care for the trees before they begin to bear. Experience has shown that this expense will average 10 cents per year per tree, provided not less than 2 hectares are planted, actual data was based in one instance on 5 hectares, and in another on 10.

This results in a cost of 30 centavos per tree in addition to the original investment, or expense of 22½ cents per tree, making a total of 52½ cents per tree from the date of planting to the bearing age.

This is the maximum average, and unless caused by ignorance or mismanagement, should not be greater; in 50 per cent of the locations it will be less. However, it is not safe to figure on less for any location along the foot of the mountain ranges where jungle and forest must be coped with.

Cost data taken from actual experience, and handled in a different manner, have given the writer practically the same results, and in different parts of the Philippine Islands has ranged from 60 cents to ₱1.85 per tree, brought to the bearing age.

The most favorable conditions which the writer has ever encountered on Luzon show that coconuts have been grown, that is, brought to the bearing age, which there is 7 and 8 years, for 60 cents per tree.

However, in that particular place the conditions were absolutely favorable, and the low cost was *due to the clever and economic administration of the planter.* Adjoining planters expended on an average of from ₱1 to ₱1.50 per tree, to bring the trees to the bearing age.

These same remarks will apply to the island of Mindanao. The maximum reliable statement is ₱1.85 per tree; however, the estimate provided for a most expensive administration.

The writer's cost data are all based upon 50 cents per day for labor, and do not include road construction, except trails and earth roads for carts, "kangas," and so forth. This is due to the fact that coconut planting has been done either on the coast or in the vicinity of navigable rivers, of which Palawan has many.

The conclusion reached, from the writer's experience, is that coconut planting for a permanent crop and investment can not be equaled by any other known permanent crop, not even rubber. It is superior to rubber in the island of Palawan. The usual argument advanced to the contrary places great value upon the fact that Palawan does not have typhoons which would damage the rubber crop—the same fact is almost of equal value to the coconut.

The attached notes regarding this feature are taken from general conditions, and not from especially favored localities.

AGUSAN RIVER VALLEY.

Comparatively little labor is to be had in the Agusan River Valley, and it would probably be necessary to bring most of that required from Iloilo. If no catch crops were planted, the land after being cleared should be gone over with bolos twice each year. It should be remembered that where Ceara rubber is planted it is nearly useless to put in a catch crop, as the rubber itself promptly occupies the ground. If Para or Castilloa is planted, such crops as corn, camotes, peanuts, or sesamum can be put in. It is impossible to state definitely the returns which would be derived, so much depends upon proper cultivation methods and good management. I am frank to say, however, that if I were to plant rubber in the Philippines, I should, in the light of my present knowledge, plant Ceara rubber, and make it that and nothing else on the ground

planted with rubber, devoting other ground to the growing of crops which give quick returns.

It should be stated that much of the land in the Agusan River Valley is apparently admirably adapted to the growing of tobacco and that there is every theoretical reason to believe that excellent tobacco might be produced there, but tobacco, like Ceara rubber, is a voracious feeder, which quickly impoverishes the soil.

BUKIDNON.

In the subprovince of Bukidnon the cost of transportation would, of course, be the ordinary cost of overland transportation by cart, and would depend directly on the distance, which might be anything from 10 miles to 120 miles, depending on the location which the planter chose to select. The products would need to be taken across the bay to Cagayan de Misamis, and be shipped thence to Cebu, although a pier might be built on the east coast of the bay, and the small cost of transportation across the bay saved.

Character of soil: Good, rich loam, in some places sandy, and in others clayey. Practically nothing but grass is at present on the land and there would be no cost for clearing, as the grass could be burned during the comparatively dry part of the year. The cost of planting would be very small, as the land would require only plowing and harrowing. The expense of maintenance, which would consist of occasional replowing and harrowing, would also be small.

Probably the best catch crop to grow on this land would be upland rice, as the country does not now produce enough rice to feed its people, owing to the scarcity of draught animals. The land should produce 30 cavans of unhusked rice per acre, worth ₱3 per cavan. The additional cost involved in putting in this rice would be practically nil, as the land would need to be plowed in any event, and the rice could be drilled in.

SOUTH PALAWAN.

The conditions as to land are the same as in Agusan.

Transportation facilities: A small steamer every three weeks from Puerto Princesa to Manila. Land might be had in the immediate vicinity of Puerto Princesa, and communication with that town maintained by launch, as the land selected would naturally be adjacent to the sea shore. The soil in south Palawan is perhaps the richest in the Islands, with the exception of that in Mindanao and Mindoro. Land can be selected which is now covered with grass, or with a comparatively light growth of bushes. This land is very suitable for raising upland rice, corn, camotes or sesamum.

MORO PROVINCE.

I am not myself sufficiently familiar with conditions in the Moro Province to give any reliable information, but such information can doubtless be had from the Provincial Secretary or from the officers of the Zamboanga Chamber of Commerce. They are progressive people down there and I am sure they will be glad to help out in any way they can.

With a few more years of experience it is to be hoped and anticipated that much more detailed information relative to rubber growing in the Philippines may be obtainable. At present we must fall back upon the fundamental proposition that conditions as regards climate and soil are ideal and that labor is to be had in a reasonable amount, and that the ultimate result will depend here, as elsewhere, on the character of the management.

Very respectfully,

DEAN C. WORCESTER,
Secretary of the Interior.

Mr. MILTON E. SPRINGER,
Secretary Manila Merchants' Association,
Manila, P. I.

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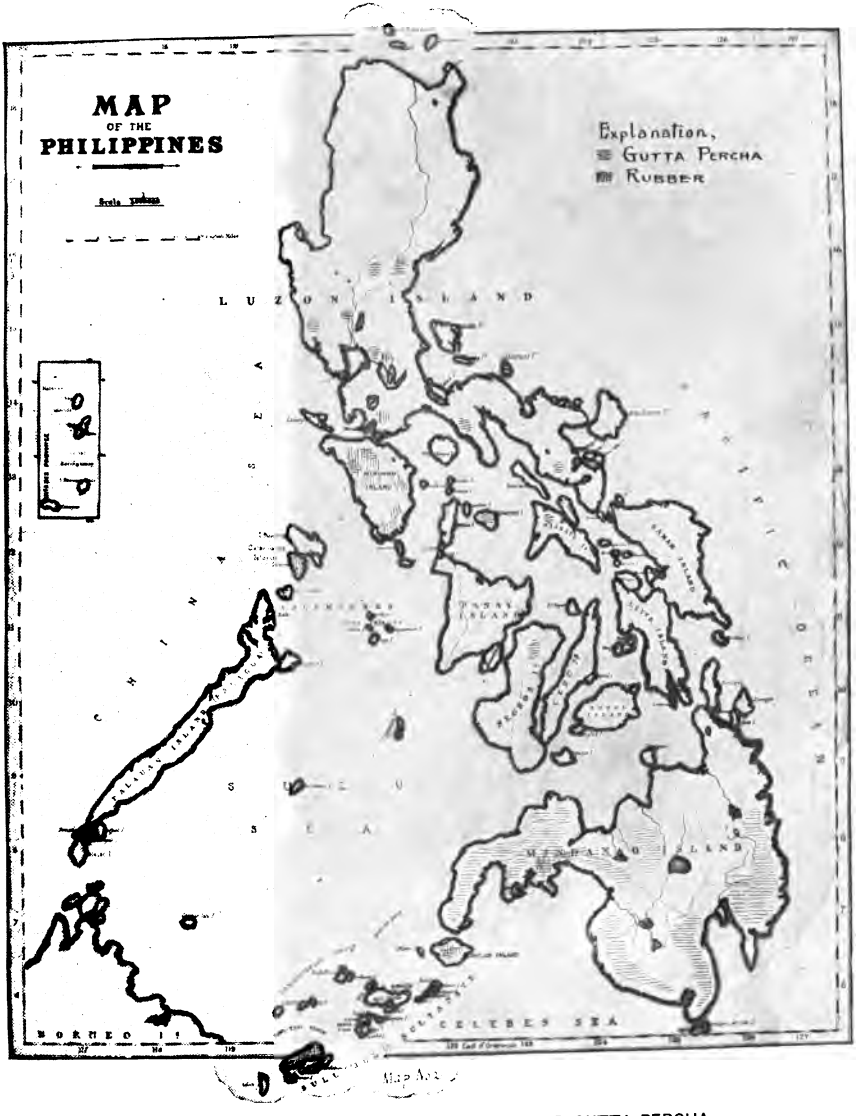
GLOSSARY.

Picul =137.9 pounds avoirdupois.
Cavan =16 gallons 3 quarts 1 pint.
Meter =39.37 inches.
Kilometer=0.62137 mile.
Kilogram =2.2046 pounds avoirdupois.
Hectare =2.471 acres.
Abaca is manila hemp.

The peso (₱), Philippine currency, is equivalent to 50 cents United States currency, and the centavo is equal to ½ cent. Except where gold is specified, the amount is expressed in Philippine currency.



MAP SHOWING DISTRIBUTION OF RUBBER AND GUTTA-PERCHA.

FIG. 22.—CHINESE TRADING BOAT COLLECTING GUTTA-PERCHA AT PARANG PARANG.

FIG. 15.—READY TO FELL A LARGE GUTTA-PERCHA TREE FOR EXPERIMENTAL PURPOSES, DISTRICT OF ZAMBOANGA, MINDANAO.

FIG. 24.—PLANTATION OF GUTTA-PERCHA TREES (PALAQUIUM GUTTA) OF VARIOUS AGES, BUITENZORG, JAVA.

FIG. 17.—TAPPING A GUTTA-PERCHA TREE SO THAT ALL THE MILK IS COLLECTED IN SHELLS BENEATH. DONE BY MOROS IN TAWI TAWI.

FIG. 19.—A GUTTA-PERCHA TREE TAPPED SO THAT MUCH OF THE MILK IS LOST ON THE GROUND, TUCURAN, DISTRICT OF ZAMBOANGA.

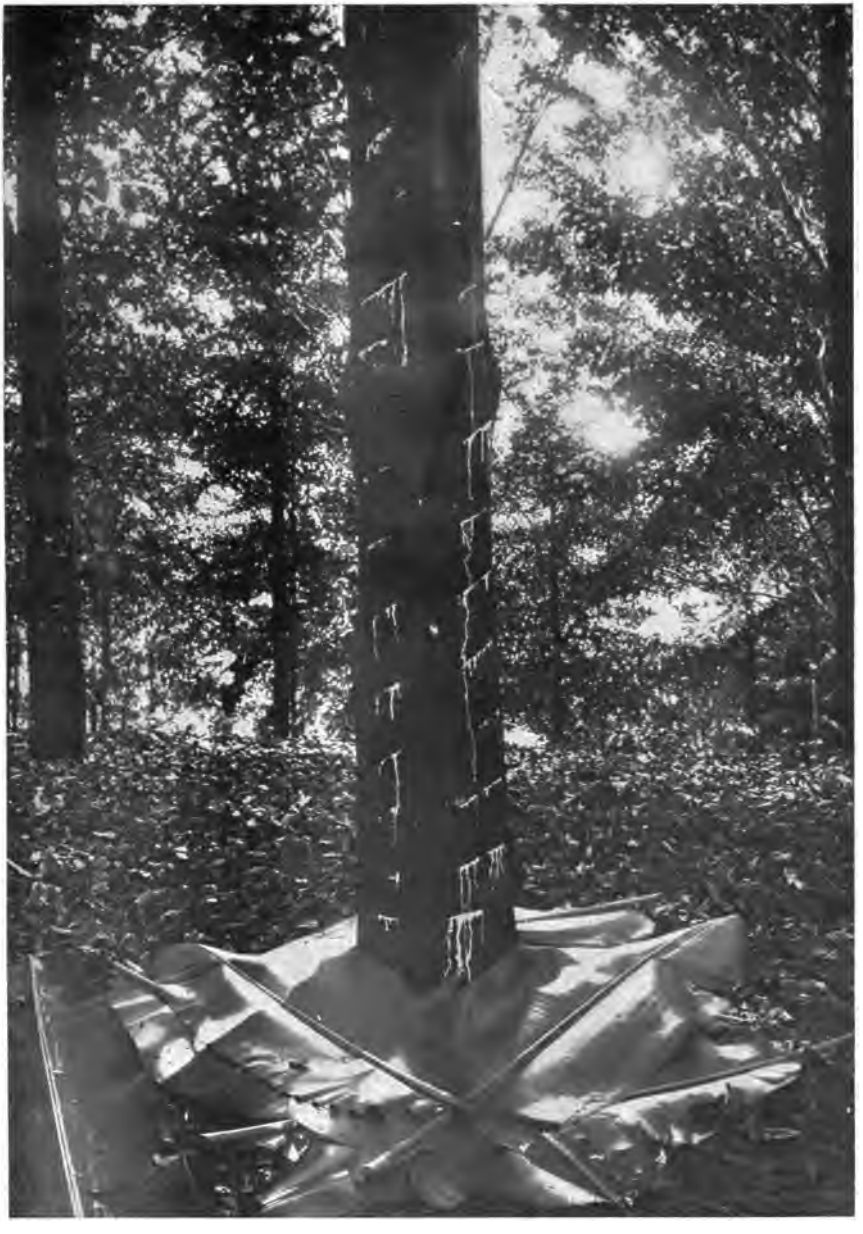


FIG. 27.—A TREE OF PALAQUIUM GUTTA JUST TAPPED, TJIPITIR, JAVA.

FIG. 29.—ABSENCE OF DEEP SCARS AFTER SEVERAL YEARS TAPPING, BUITENZORG, JAVA.

FIG. 31.—A RUBBER VINE (PARAMERIS PHILIPPINENSIS RADLK), WESTERN MINDORO.

FIG. 38.—PLANTATION OF INDIA-RUBBER TREES (FICUS ELASTICA), BUITENZORG, JAVA.

FIG. 39.—EXHIBIT OF PARA RUBBER, SHOWING YIELD OF TREES AND METHODS OF PREPARING FOR MARKET, PERAK PROVINCE, FEDERATED MALAY STATES.

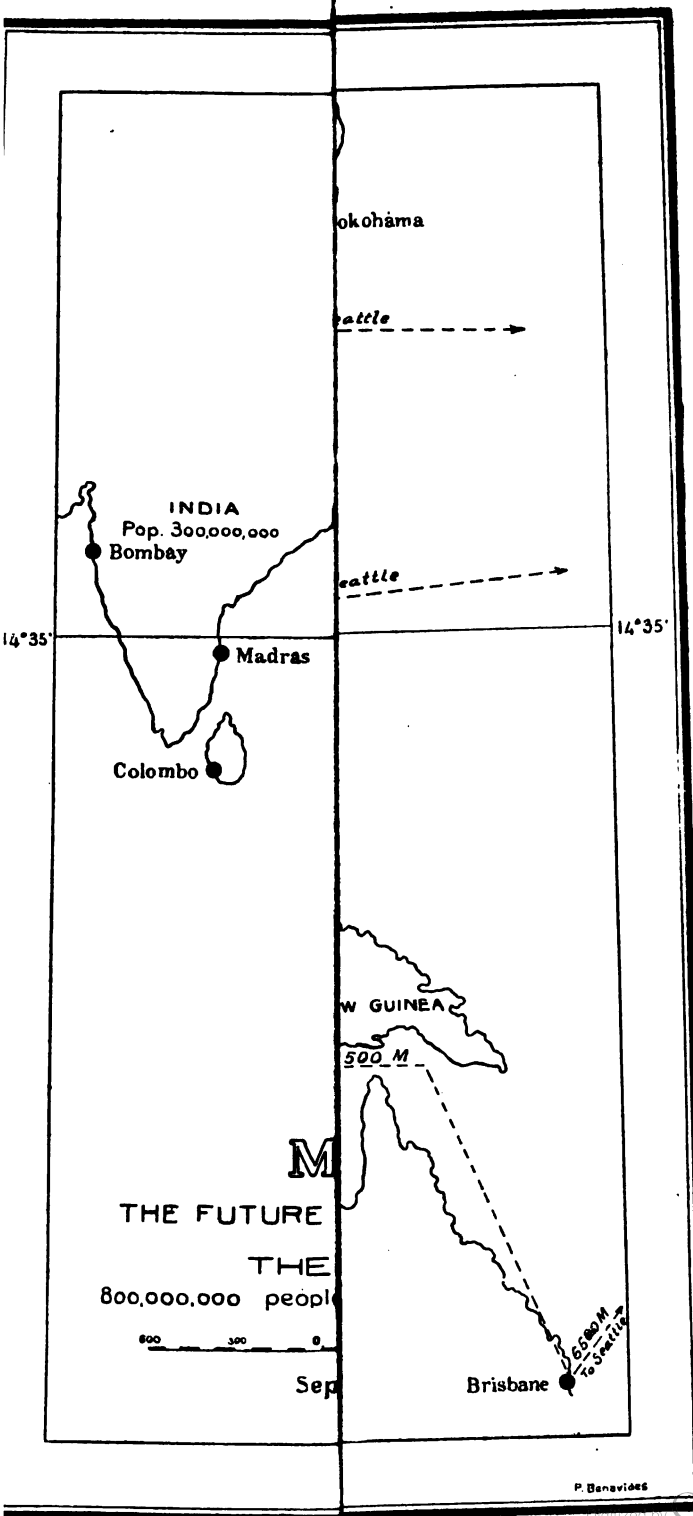
FIG. 41.—PLANTATION OF PARA RUBBER TREES, PRODUCING SEED, BOTANICAL GARDEN, SINGAPORE.

FIG. 36.—METHOD OF TAPPING A PARA RUBBER TREE THIRD DAY AFTER TAPPING, EXPERIMENTAL GARDEN, BUITENZORG, JAVA.

FIG. 42.—CEARA RUBBER PLANTS, EXPERIMENT STATION, MALATE.

FIG. 1.—MORO SAILBOATS, "VINTAS."

FIG. 35.—PIECE OF DRY BARK FROM RUBBER VINE, SHOWING THE IMMENSE NUMBER OF RUBBER FIBERS IN THE INNER BARK.



of merchantable timber—that is, accessible timber for which

he Government and is available for exploitation.
a virgin forest, much of which can easily be logged by steam.
Dipterocarp family, generally found in almost pure stands.
of 7 feet and more.
Philippines. Their uses vary from the richest cabinetwork to
h wood is put for which some Philippine wood is not adapted.
ul Philippine woods are sold abroad as substitutes for mahogany,

nt placed on the market and timber users find difficulty in filling
ary to import Oregon Pine and California Redwood because
to fill the local demand.
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for the Far East. There are 800 million people within its

s and it is admitted free into the United States. Sawmill and
f duty into the Philippines.
alf and less than half the stumpage prices asked for similar
and minor forest products are sold; the land remains in the

one. He will find that he has escaped many of the vexatious
ew in the Philippines. Dollar for dollar of outlay, much better
from Filipino than from American labor.
ıd operating in a suitable tract should be able to deliver many
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faith is all that is required. Exclusive privileges for 20 years
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ıble for exploitation.
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grow in portions of the Philippines, and the forests all over
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e by the Bureau of Forestry. All available maps, estimates
sing are placed at their disposal. Arrangements can be made
in the field. Managers and investors may depend upon the
rise.

n to the Director of Forestry, Manila, P. I.